TOWARD ENERGY EFFICIENT HOMES IN IOWA

Energy Efficiency Study Committee

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What can we, as partners in making energy efficient buildings, do?

1. **Insulate under basement floors in new homes to R-10**
2. **An energy audit for existing homes that includes building envelope leakage and the entire heating system, including ductwork**
3. **Require appraisers to place a value on energy upgrades for both new and existing homes**

The Landscape

- **NEW HOMES**
- EXISTING HOMES

How we look at each,
and what we can do for each,
is different

The Language

The Science & Math of energy flow

Heat crosses the building envelope in only 3 ways:
conduction, convection, radiation.
Conduction (insulation), roughly accounts for 1/3 - 1/2
Convection (air flow), also accounts for 1/3 - 1/2
Radiation (electromagnetic) accounts for the rest

Heat flow, (in Btu/hr) through insulation depends on conductance (U), sq. ft. area (A) and temperature difference from inside to outside (ΔT):

Btu/hr = U x A x ΔT

Heat flow by air movement depends on air flow rate (CFM), temperature difference inside to outside (ΔT), and correction factor (1.08):

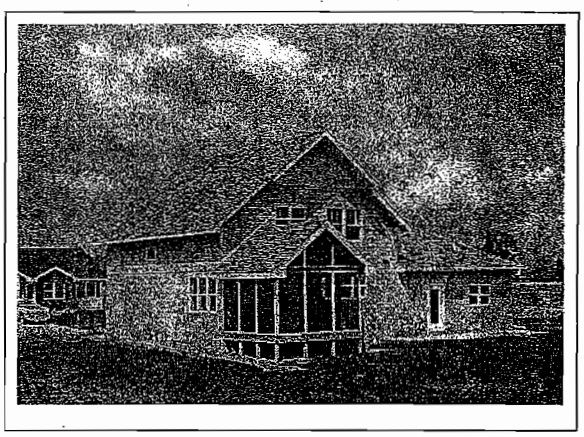
Btu/hr = CFM x ΔT x 1.08

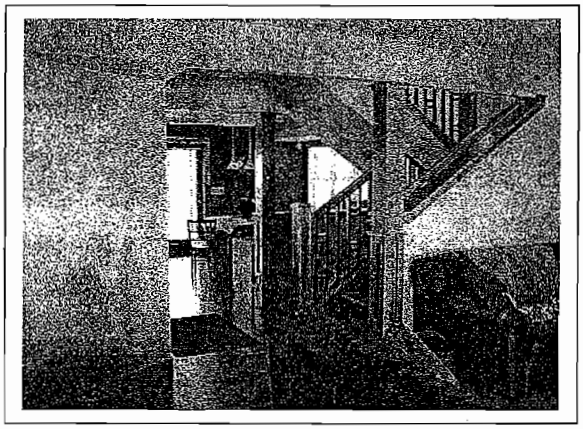
These are powerful tools

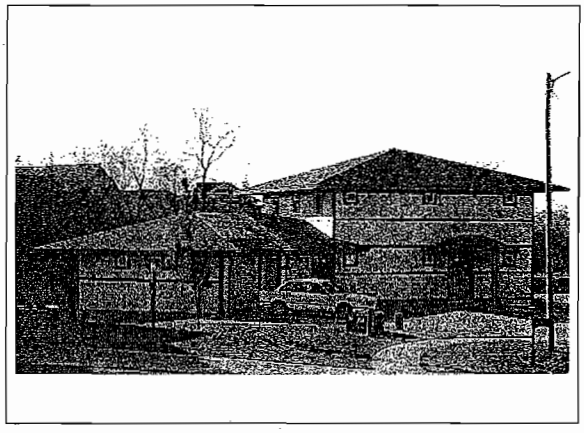
These formulas can tell us what makes a big difference, and what doesn't matter
They can show us where we've been and where we should go
They are what the HVAC contractor (should) use to design your heating system

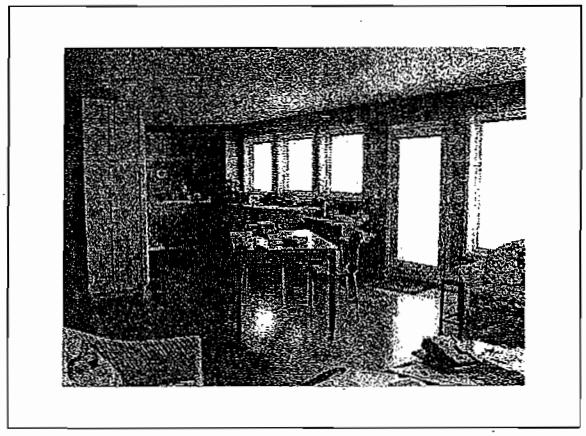
Let's start by looking at a couple **NEW homes**

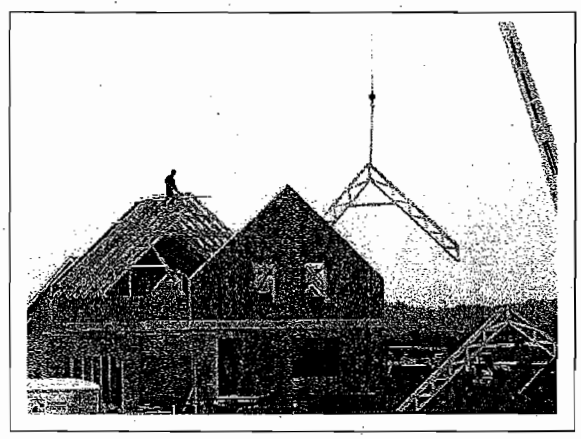
Ones where we could do everything at the right time, to build the best we know

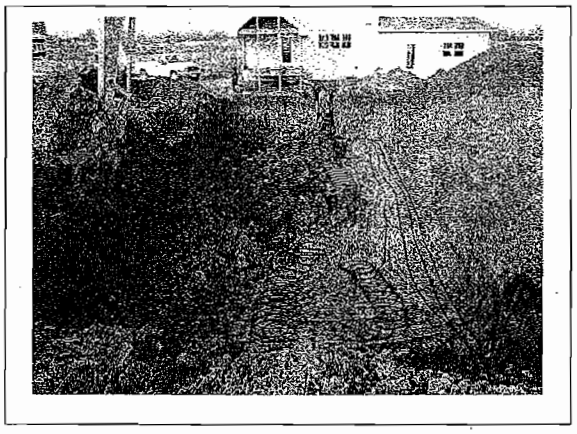












Does doing all this stuff make a difference?

- The home in Solon costs under $200 a <u>year</u> to heat
- It keeps 36,000 lbs of CO_2 out of the air
- The home *always* feels fresh and comfortable
- The benefits will last the life of the house

Let's pick some low-hanging fruit

The formula for heat flow through insulation, Btu/hr = U x A x ΔT
Assuming a 1-story, 1,000 sq ft house, (a 32' x 32' house walls also = ~ 1,000 sq ft)
an inside temperature of 70° and cold outside winter temperature of 0°F

Ceilings (R-40, U=0.025) 1,000 x 0.025 x 70 =	1,750 Btu/hr
Walls (R-20, U=0.05) 1,000 x 0.05 x 70 =	3,500 Btu/hr
Un-insulated basement floor (R-1, U=1.0) 1,000 x 1.0 x 20 = (the temperature below grade is about 50°, so the difference is only 20°, not 50°)	20,000 Btu/hr!

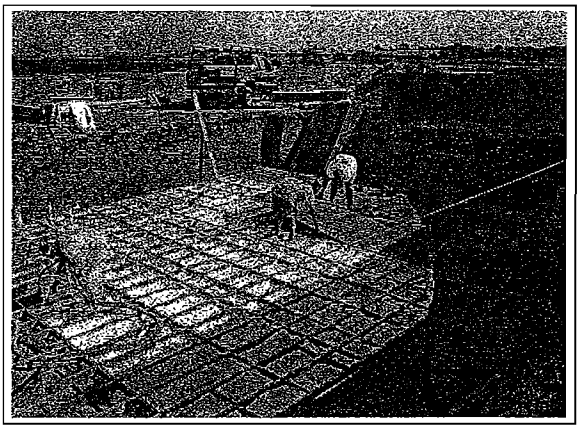
But what if we installed insulation under the floor to R-10?

R-10 (U = 0.1): 1,000 x 0.1 x 20 =	2,000 Btu/hr

If someone says "Adding basement floor insulation is too expensive", the formula can help you answer "How much energy do you want to lose?"

1. I recommend we insulate under new basement floors to R-10

- with tax incentives, utility rebates, adoption and enforcement of of code changes, etc.
- We can do this with rigid board insulation or sprayed foam…



EXISTING HOMES

For each new house built, there are 80 existing ones

That's a significant opportunity to make a big difference

How many ways do homes lose energy? How much? Where?

- Inadequate insulation
- Air leakage
- Poor windows
- Inadequate ductwork

How do you know what to fix?

Some houses leak enough air to replace five times *(or more!)* its whole volume in an hour

How much energy do we lose by air leakage?

(Air flow Btu = CFM x ΔT x 1.08)

For **5 air changes per hour** (ACH) and 1,000 sq ft:

1,000 sq ft x 8' x 5 ach/60min = 667 CFM. 667 CFM x 70° x 1.08 = **50,350** Btu/hr

Current ventilation standards (ASHRAE 62.2, 2004) recommend 7.5 CFM per person plus 1 CFM per 100 sq ft. For a three-BR house, a couple with 2 kids, per 1000 sq ft:

40 CFM x 70 x 1.08 = **3,024** Btu/hr

That's saving 94% of the energy we waste to heat the winter sky

If we installed an energy recovery ventilation system, we could even recover 60 to 80% of that. Minnesota already requires one in all new homes.

Inadequate Ductwork

- 47% of the energy produced by the furnace in existing homes never reaches the register. HUH?

Filters with too much air restriction, ducts too small, too many bends, too leaky, registers too small

- That can reduce a 92% efficient furnace to 43%

How do we know what to fix in an existing home? And where?

We can't just look at it

We need trained people with the proper diagnostic tools -- HERS Raters, (Home Energy Rating System) who can pinpoint how many and where to fix energy problems.

It could save thousands per home on unneeded repairs, or wasted effort on inconsequential fixes

2. I recommend that homes get complete energy audits

that measure not just windows, amount of insulation and furnace efficiency, but

- building envelope air leakage
- entire heating system performance

The audit costs between $300 - $400

Tax incentives could be offered for the first one, and each time the home is sold

The report could be part of a Realtor's MLS information

HOW TO AFFORD IT

Mortgage payments and utility bills are regular monthly payments

If utility bills are lower, you can afford a higher mortgage, but not if they're not part of the loan

Loans are based on appraised value

Banks need appraisers to place a value on energy upgrades

3. I recommend that appraisers be required to place a value on energy upgrades

Thank you very much

- This powerpoint will be available on my Website, ***dpoconstruction.com***